

3. ADAPTIVE MANAGEMENT

HOW WE MAKE DECISIONS

How Do We Make Decisions? *Adaptive Management*

How the Puget Sound Partnership does Adaptive Management

As we take action to recover the Puget Sound ecosystem, the Puget Sound Partnership and our numerous partner agencies and organizations also ask:

- What have we learned about Puget Sound and ecosystem recovery?
 - * What are the specific concerns to be addressed by recovery efforts?
 - * What are the best approaches for protection and restoration?
- How can we use new understandings to improve ecosystem-based management of Puget Sound?

By asking and answering these questions across the multitude of recovery efforts occurring throughout the region, we aim to develop science-based innovations for recovery, diffuse information and conclusions about best practices, and improve Puget Sound ecosystem recovery. This approach has been called evolutionary problem solving—a form of adaptive management.

Grounded in an adaptive management framework, the Puget Sound Partnership leads collaborative efforts to plan, evaluate, and improve solutions to achieve Puget Sound recovery. This means that we:

- Develop and prioritize solutions by:
 - * Selecting indicators for assessing recovery.
 - * Articulating desired future conditions.
 - * Developing and articulating the logic of strategies and actions by illustrating how they act on ecosystem pressures and contributing factors.
 - * Projecting the expected results of actions relative to recovery goals and objectives.
- Track and monitor results by:
 - * Monitoring implementation, effects of actions, and ecosystem conditions.
 - * Assessing outcomes to compare measured results to expected results.
 - * Evaluating the accumulated information about actions and monitoring results.

Connecting these efforts in an adaptive cycle (see figure on page 167), we learn, capture and share this learning, and apply this learning to adjust plans and actions. The Partnership engages in an ongoing process of feedback and learning to periodically revisit decisions—for example, about the specific goals and objectives of ecosystem recovery, the strategies and actions to include in the Action Agenda, and the relative priority of strategies and actions—and to clearly and transparently update the assumptions underlying each decision.

The Partnership's experiences in adaptively managing the Action Agenda's foundation of ecosystem indicators, recovery targets, and pressures include:

- **Adopting ecosystem indicators.** In early 2010, a team of scientists developed candidate portfolios of ecosystem indicators to represent the Puget Sound ecosystem using a scientific process outlined in the Puget Sound Science Update. The Leadership Council used these candidate portfolios and their judgments about the “resonance” of the candidate indicators to adopt 20 ecosystem indicators in July 2010. The decision to adopt indicators concluded an adaptation of the Partnership's suite of indicators, transitioning from the provisional indicators selected by the Science Panel in 2009, and building from published scientific information and scientific advice.
- **Setting 2020 ecosystem recovery targets.** In late 2010, the Science Panel advised that a “first iteration of target setting should commence immediately and consider ecological and social tradeoffs by simultaneously examining, and providing targets for as many of the 20 dashboard indicators as possible.” In 2011, the Partnership established 2020 ecosystem recovery targets for most of the Dashboard indicators and for reductions in a few high priority pressures. The 2011 target setting effort did not accomplish simultaneous consideration of targets, but did allow stakeholders and decision makers to consider ecological and social tradeoffs in considering specific targets. The Leadership Council, when it adopted 2020 ecosystem recovery targets, was informed by scientific input, considered stakeholder perspectives, and reflected a balance between being achievable and results-oriented. The adoption of specific targets as guides for ecosystem recovery was a significant adaptation in the Partnership's approach to ecosystem recovery and was responsive to scientific advice.
- **Articulating the pressures affecting ecosystem recovery.** The Science Panel advised in late 2010 that “there is an urgent need [for] a comprehensive analysis of threats” to the Puget Sound ecosystem. As of Fall 2012, work is underway to design this type analysis and resources have been allotted to carrying it out. To support the 2012 revisions to the Action Agenda, the Partnership refined the pressures presented in the 2009 State of the Sound report to 1) address concerns

What is Adaptive Management?

Adaptive management is an explicitly scientific approach to management in complex systems to test assumptions in order to learn and adapt.

☑ **Testing assumptions** involves developing and stating assumptions about a situation, designing and implementing an action, and monitoring to see how actual results compare to what was predicted.

☑ **Learning** is about systematically documenting the processes used and the results achieved.

☑ **Adaptation** is about improving actions based on the results of monitoring and learning.

raised by reviewers, 2) better align the list of the pressures with published categorization schemes, and 3) better articulate pressures as stressors, sources of stress, and stressed conditions of ecosystem components. In 2012, the Partnership elicited expert opinions re-evaluate pressures whose definitions had changed or whose 2009 ratings were criticized by reviewers. More complete revisions will occur through the “comprehensive analysis” recommended by the Partnership’s science advisors.

Building on this foundation, the Partnership led a process of revising Action Agenda strategies and actions in 2012, including:

- **Revising strategies for five key pressures.** In 2011, the Partnership convened interdisciplinary teams to discuss approaches to reducing five key pressures on the Puget Sound ecosystem: land development, shoreline alteration, floodplain alteration, stormwater, and wastewater. Each team combined scientific and policy expertise to create a conceptual model reflecting current understandings of the situation and to identify and evaluate opportunities for management intervention. The output from these teams was a key contribution to revised protection, restoration, and pollution control strategies presented in the December 2011 draft version of the *2012 Action Agenda*.¹
- **Selecting Near Term Actions for the 2012 Action Agenda.** Combining information from the interdisciplinary team-led efforts described above with information on implementation of Near Term Actions in the *2009 Action Agenda*, Partnership staff and partners proposed Near Term Actions and key ongoing program activities to include in the December 2011 draft of the *2012 Action Agenda*. Unfortunately, information about the effects of prior-implemented actions was not generally available to inform the selection or refinement of Near Term Actions for the *2012*

Action Agenda. One exception is the measured effectiveness of storm system cleaning by the City of Tacoma to reduce legacy pollutant loads—see local story on page 139-140—which provided the rationale for including additional storm system cleaning as a Near Term Action in the *2012 Action Agenda*. The primary scientific basis for the selection of most Near Term Actions was the conceptual understanding of expected results.

- **Rating 2012 Action Agenda sub-strategies based on an evaluation of their ecological importance.** The Partnership’s science program and Science Panel members led an effort that concluded in June 2012 to assist decision makers in identifying priority Action Agenda sub-strategies. Using the professional expertise and knowledge of 40 individuals, the ecological outcomes of Action Agenda sub-strategies were characterized based on the pressures addressed; the ecosystem components affected; and the ecosystem structures, processes, species, and food webs protected and restored. The characteristics used to evaluate sub-strategies and their relative weighting were developed by Partnership scientists following guidance from the Partnership’s Ecosystem Coordination Board. This approach provided a more transparent and objective basis for ranking sub-strategies compared to the approach used in 2008. Note, however, that this approach has not yet been combined with information on implementation issues to generate a priority list of sub-strategies. The results available in Appendix G of the *2012 Action Agenda* are ordered lists of sub-strategies based on evaluation of their ecological outcomes.
- **Defining strategic initiatives to guide Partnership and partners’ priorities for 2012 and 2013.** In the *2012 Action Agenda*, the Partnership has identified three Strategic Initiatives meant to deliver a

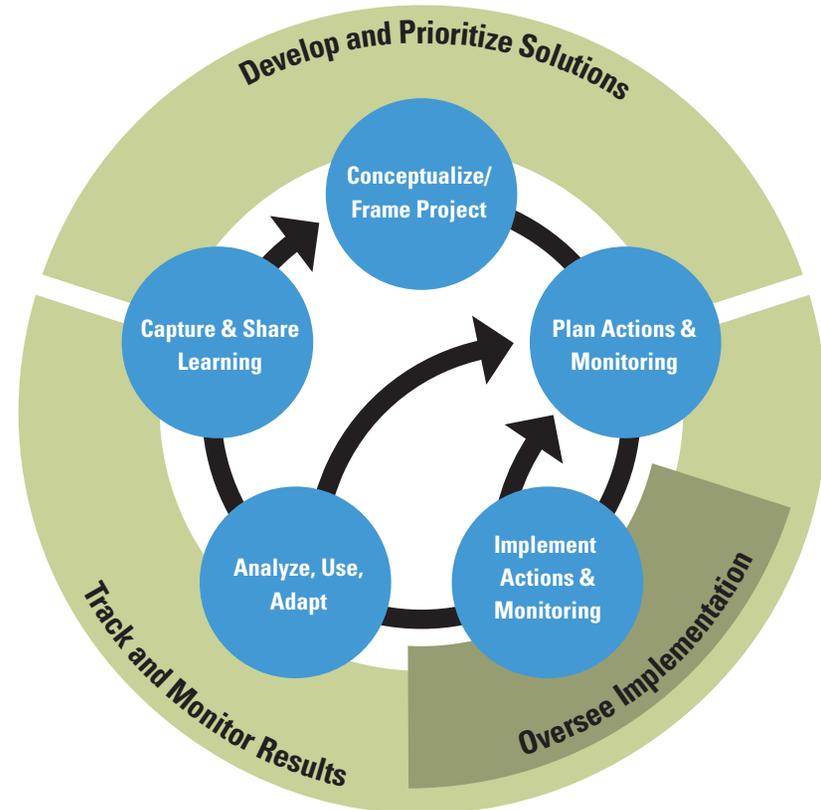
¹ Revisions to other strategies were identified by Partnership staff discussions with lead implementers (e.g., consulted with the Department of Ecology and their core team for toxic chemicals and nutrient controls to revise toxic chemical control strategies to better align with Ecology initiatives and strategies).

substantial level of progress on focused, strategic sets of actions related to the challenges of urban stormwater runoff, protection and restoration of habitat, and recovery of shellfish beds. The specific actions included within each Strategic Initiative were drawn from policy discussions and were checked against the rating of strategies based on the importance to achieving ecological outcomes.

Adaptive management depends on the integration of the scientific process, investigation, and findings into ecosystem recovery. The following efforts of the Partnership's strategic science program, as supported by the regional scientific community, have fueled recent adaptations:

- **Puget Sound Science Update.** In 2010, the Science Panel delivered an initial publication of the *Puget Sound Science Update* to the Partnership's Executive Director. This document provided critical information to support the adaptations discussed above related to adoption of ecosystem indicators and ecosystem recovery targets. The section of the Update on ecosystem protection and restoration strategies provides relatively little information about the effectiveness of strategies and actions; this gap in information has affected the ability of the Partnership to base revisions of the Action Agenda on an evaluation of the effects of actions.
- **Establishing a Puget Sound Ecosystem Monitoring Program (PSEMP).** Please see the discussion of PSEMP in chapter 1 for an introduction to Puget Sound's ecosystem monitoring.
- **Engaging the Partnership's Science Panel and the regional science community to provide scientific review and advice.** As described in many of the paragraphs above, the science community has supported adaptation by providing scientific advice related to ecosystem recovery, e.g., adopting indicators and setting targets.

The Puget Sound Partnership's Primary Responsibilities (shown in green) are interrelated in an adaptive cycle (shown in blue)²



²This is a modification of the project management cycle presented in the *Open Standards for the Practice of Conservation (CMP 2007)*

Adaptive Management Example: *Revising implementation strategies based on the importance of contaminants released from creosote-treated wood*

In late 2011, the Department of Ecology completed a multi-year scientific study of toxic chemical loading to Puget Sound, "Primary Sources of Selected Toxic Chemicals and Quantities Released in the Puget Sound Basin." This report identified creosote-treated wood as one of the largest sources of PAHs (polycyclic aromatic hydrocarbons) released to the Puget Sound environment

This result was surprising to a number of people engaged in toxic chemical control issues. As people learned of this finding, an effort was made to adjust toxic chemical control strategies to reflect this finding. For example:

- A Near Term Action to inventory and remove creosote pilings (B2.2 NTA4) is included in the *2012 Action Agenda*. This continues work that DNR and others have been undertaking since 2007 but represents a substantially greater prominence for this issue in the Action Agenda compared to the 2009 version.
- As the lead organization for controlling toxic chemical and nutrient pollution, the Department of Ecology has recently awarded approximately \$500,000 to DNR for removal of creosote piling as a key investment for PAH control.

In addition, conducting scientific review ensures the credibility of the processes and information the Partnership uses to fuel adaptations. For example, the third-party review of the assessment report concluding the multi-year study of toxic contaminants loading to Puget Sound provided some assurance that the study conclusions reflected the findings and provided a sound basis for revised strategies and actions (see sidebar on creosote materials on this page).

Finally, adaptive management depends on individual and institutional learning. The Partnership's application of adaptive management has included the following efforts to facilitate, capture, and share learning:

- **Encyclopedia of Puget Sound.** A project of the University of Washington's Puget Sound Institute, the *Encyclopedia of Puget Sound* is designed to facilitate collaborations and partnerships among leading researchers and agencies to help deliver scientific findings to scientists and policymakers. By maintaining and improving the information presented in the *Puget Sound Science Update* as part of the *Encyclopedia of Puget Sound*, the Institute and Partnership hope to encourage information sharing and synthesis to facilitate learning within the scientific community and to provide a means for that learning to spread to those engaged as implementers and stakeholders for ecosystem recovery actions.
- **2011 Salish Sea Ecosystem Conference.** Building on a nearly 25-year history of conferences on Puget Sound ecosystem science and management, the Partnership worked with Environment Canada and others to convene the 2011 Salish Sea Ecosystem Conference. This event offers a forum for presentation and discussion of scientific findings that facilitates learning by scientists, implementers, and stakeholders.

In 2009, the Partnership adopted the Open Standards for the Practice of Conservation to facilitate science-policy interactions in which we revisit program design and implementation approaches based on information and conclusions from monitoring of recovery efforts and ecosystem conditions. The Partnership’s experiences summarized above reflect our recent

experience working in the Open Standards framework. Upcoming efforts to fuel adaptation based on this framework are indicated in the table below, which identifies the Open Standards process step (shown as columns in the table) addressed by various projects that the Partnership undertakes to carry out our responsibilities (shown as rows in the table).

Application of Open Standards to Puget Sound Partnership responsibilities

Puget Sound Partnership responsibilities	Steps in <i>Open Standards for the Practice of Conservation</i>		
	Conceptualize and plan (steps 1 and 2)	Analyze, use, adapt (step 4)	Capture and share learning (step 5)
Develop and prioritize solutions	<ul style="list-style-type: none"> Set interim targets Assess pressures - LIOs Assess pressures - overall Revise indicators Revise targets 	<ul style="list-style-type: none"> Assess selected indicators (Washington Academy of Sciences, etc.) Review targets 	<ul style="list-style-type: none"> Vital Signs reported on web
Foundations			<ul style="list-style-type: none"> State of the Sound Action Agenda and biennial science work plan Science review in Encyclopedia of Puget Sound Salish Sea conference PSEMP reports Leadership Council performance forums Government Management Accountability and Performance (GMAP)
Strategies and actions	<ul style="list-style-type: none"> Revise sub-strategies and NTAs Identify priority strategies and actions - LIOs Identify priority strategies and actions - Action Agenda 	<ul style="list-style-type: none"> Adjust NTAs Evaluate prospective strategies (e.g. modeling effects of changing nutrient loads on dissolved oxygen in marine water) 	
Track and monitor results	<ul style="list-style-type: none"> Develop ecosystem monitoring approach (PSEMP) Develop watershed-scale monitoring and Adaptive Management plans 	<ul style="list-style-type: none"> Monitor and report on... <ul style="list-style-type: none"> Status and trends (overall, salmon, etc.) Effectiveness (programs, actions, etc.) Implementation (NTAs and programs) 	

Note: This table lists projects related to two of the Partnership’s three responsibilities. The Partnership’s responsibility to “Oversee Implementation” and the related Open Standards step, “Implement Actions and Monitoring”, (step 3) are not included in this presentation.

The Partnership’s efforts to track and monitor results addresses questions about ecosystem status and trends and about the implementation and effectiveness of recovery efforts. General forms of evaluation questions related to Puget Sound ecosystem recovery are presented in the table below. Monitoring and evaluation to address these questions involves expertise and capacity from the Partnership’s performance management and fiscal staff (question 1 and part of question 2) and from the Puget Sound

ecosystem monitoring program (questions 2 and 3). In the discussion above about the 2012 revisions to Action Agenda strategies and actions, we noted that information related to the effectiveness questions has not generally been available. Additional effectiveness monitoring, perhaps combined with other program evaluation approaches, will be needed to support future adaptations of recovery strategies and actions.

Track and monitor results to answer questions about Puget Sound ecosystem recovery

Evaluation questions	Recovery elements
<p>1. Have actions occurred as planned?</p> <p>Fiscal monitoring - <i>How much spent? Spent as directed?</i></p> <p>Implementation monitoring - <i>Was action completed as planned?</i> <i>is it outcome persisting?</i></p>	<p>Input (e.g. funding)</p> <p>immediate outcome, activity, output</p>
<p>2. Are strategies and actions having expected results?</p> <p>Effectiveness monitoring - <i>Are actions creating intended outcomes?</i></p> <p>Implementation monitoring - <i>Are actions 'causing' desired effect?</i></p>	<p>intermediate outcome (activity -> output)</p> <p>intermediate outcome (activity -> activity -> output)</p> <p>intermediate outcome (e.g. pressure reduction)</p>
<p>3. What is the condition of the system?</p> <p>Status and trends monitoring <i>What is the biophysical and socio-economic status of Puget Sound</i></p>	<p>Ultimate goal - ecosystem recovery (per goals)</p>